

THE ECONOMY AND TRAINING OF MEMORY

BY

HENRY J. WATT

LECTURER ON PSYCHOLOGY IN THE UNIVERSITY OF GLASGOW AND
TO THE GLASGOW PROVINCIAL COMMITTEE FOR THE
TRAINING OF TEACHERS

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PREFACE

DURING the last twenty-five years the experimental study of memory has made considerable progress, and valuable results have been obtained. Many of these have an important bearing upon practice and upon the economy of effort. The aim of the following pages is to make these results more accessible to students and teachers, and to win for exact psychology some part of the interest and attention which it will command in the future.

H. J. W.

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CONTENTS

CHAPTER	PAGES
I. INTRODUCTION	1—10
1. CAN THE NATIVE FACULTY OF MEMORY BE IMPROVED ?	1
2. WHETHER WE EVER COMPLETELY FORGET ANYTHING	4
3. THE DEFINITION OF MEMORY: DISTINC- TION FROM TRACE OF INFLUENCE . .	5
4. THE EXPERIMENTAL INVESTIGATION OF MEMORY -	6
5. SYSTEMS OF MEMORY TRAINING . . .	8
6. CONCLUSION	10
II. THE EXPERIMENTAL INVESTIGATION OF MEMORY	11—24
7. THE MATERIAL	11
8. METHOD OF TAKING INTO THE MIND . .	13
9. MEMORY MEASURES: (a) THE NUMBER OF REPETITIONS	14
10. (b) THE NUMBER OF SPECIFIED RECALLS .	15
11. (c) RECALL TIMES	17
12. (d) OTHER MEASURES	19
13. ASSOCIATION: ITS DEFINITION . . .	21
14. QUANTITATIVE DISTINCTION BETWEEN ASSOCIATIONS	23
15. PROBLEMS STATED	24

CHAPTER	PAGES
III. SOME GENERAL QUESTIONS	25—39
16. IS ALL MEMORY MECHANICAL ?	25
17. HAS THE CHILD A BETTER MEMORY THAN THE ADULT ?	28
18. DOES MEMORY RUN PARALLEL TO INTELLIGENCE ?	31
19. HOW MUCH CAN BE DONE BY MERE EFFORT OF ATTENTION ?	33
20. MEMORY AND THE ENERGY OF MIND AVAILABLE	38
IV. THE FACTORS WHICH INFLUENCE MEMORY	40—85
21. IMMEDIATE MEMORY	40
22. THE NUMBER OF REPETITIONS	41
23. THE SHORTEST ASSOCIATION IS THE STRONGEST	43
24. SOME HELPS AND HINDRANCES TO THE FORMATION OF CORRECT ASSOCIATIONS	44
25. INFERENCES	47
26. LEARNING IN WHOLE OR IN PARTS :	
(a) FAMILIAR MATTER	48
27. (b) MATTER WITH SPECIAL DIFFICULTIES	52
28. (c) VERY LONG PIECES	54
29. THE DISTRIBUTION OF REPETITIONS	55
30, 31. INFERENCES	57
32. OLD ASSOCIATIONS LOSE STRENGTH LESS RAPIDLY THAN NEW ONES	61
33. THE PERSISTENCE OF IDEAS	63
34. A PAUSE AFTER LEARNING	66
35. LEARNING WITH PERIODIC PAUSES	67

IV. THE FACTORS WHICH INFLUENCE MEMORY—(continued)

36. RHYTHM	69
37. LEARNING UNDER PRESSURE	70
38. LOCALISATION	72
39. THE WILL TO REMEMBER	75
40. HOW WILL AIDS MEMORY	78
41. PLEASANT RESULTS HELP THE MEMORY	82
42. TRUST THE MEMORY	83

V. MENTAL IMAGERY

43. INTRODUCTION	86
44. RESULTS OF EARLY PSYCHOLOGICAL INVESTIGATION—THE THREE TYPES	88
45. LATER WORK	90
46. FACTORS DETERMINING IMAGERY: (a) THE MANNER OF PRESENTATION	91
47. (b) PURPOSE IN REMEMBERING	92
48. (c) PREDISPOSITION OF INDIVIDUALS TO CERTAIN KINDS OF IMAGERY	93
49. SOME EXTERNAL SIGNS OF TYPE OF IMAGERY	95
50. THE SCOPE OF IMAGERY: (a) IN ACTION	97
51. (b) IN THOUGHT	98
52. INFERENCES: (a) DO NOT MULTIPLY IMAGERY UNNECESSARILY	101
53. (b) POSITIVE RULES	102
54. (c) IN GENERAL, VISUALISE	103
55. (d) WORK IN GROUPS AND THE TEACHING OF CHILDREN	106

CHAPTER	PAGES
VI. ON THOUGHTS	109—122
56. THERE ARE THOUGHTS	109
57. THE LAWS OF MEMORY FOR THOUGHTS DIFFER FROM THE PRECEDING	112
58. SOME EXPLANATION OF THE ABOVE	114
59. THOUGHT LINKS AS AN AID TO MEMORY	117
60. THE PLACE OF MEMORY IN CONSCIOUS LIFE	119
VII. RULES FOR THE ECONOMY AND TRAINING OF MEMORY	123—128

THE ECONOMY AND TRAINING OF MEMORY

CHAPTER I

INTRODUCTION

1. Can the Native Faculty of Memory be Improved?

THERE is almost a consensus of opinion at the present time that the native faculty of memory cannot be improved. Each man is born into the world with a certain capacity for remembering, and all he can do is to use his talent to the best effect. Now, while this opinion does correspond in some fashion to the present state of our knowledge, it can hardly be held to be an adequate expression of it. The fact is, we do not know what absolute memory means. We have knowledge of a number of circumstances which have a good or bad effect on the work of memory—which, in other words,

2 ECONOMY AND TRAINING OF MEMORY

· increase or decrease the amount learned, or the amount remembered after a certain time, or the speed of learning. But we certainly do not yet know all these circumstances, and while we believe that, apart from helping or hindering circumstances, the native power of memory varies from man to man, we have not yet been able to give numerical expression to these variations. It is even possible that no such ultimate variations exist. Besides, if they do exist, there is no good reason why we should not hope one day to discover a means of improving memory, just as we have discovered the means of combating disease, and of increasing the health and strength of individuals. This would, however, simply mean that we had discovered factors hitherto unknown, whose temporary operation produced a permanent improvement in memory power. There is, indeed, little reason for the assertion that the native faculty of memory cannot be improved, except the fact that we do not often observe a spontaneous improvement of memory. Yet, in view of the fact that a spontaneous and

permanent deterioration of memory is no uncommon occurrence, we might well believe that the native faculty of every normal man is the same—that is, the best possible—apart from the help or hindrance given by factors of temporary duration. For these reasons it is better at present not to suggest the possibility of an improvement in memory, but only to teach how the memory may be used most economically, how it can be got to do the most with the least effort.

A certain general vigour or weakness may be characteristic of the memory of any one person, but that this vigour is not so great for some things as for others is a matter of popular knowledge. It changes with the needs, habits, interests of the individual, and with a hundred other circumstances. Besides, to talk of a native faculty of memory suggests that we have accounted for all that might hinder or help memory, and have sifted out the essence of memory itself and measured its strength. We are, of course, still far from this goal of memory study. We shall have a better view

4 ECONOMY AND TRAINING OF MEMORY

of it after we have travelled farther over the road of careful and accurate investigation, and it is probable that we shall then not talk of a faculty of memory, which might be improved as a whole, but of many processes of memory, each helping to build up the whole, and each brought about with the least expenditure of energy.

2. Whether we ever completely Forget Anything.

It is quite another question whether we ever completely forget anything. Most people imagine we do not. The preoccupations of our daily life and our vivid memory of many details of the past hide from us what we have forgotten, though every now and then the veil is lifted, and we recover with joy or dismay the memory of some forgotten word or deed. On the other hand, those who have lost hope and take refuge in the past, as well as those who are fretful of the past and brood over it repentantly and complainingly, soon come to the conviction that nothing is really beyond

recall. To persistent brooding even the dimmest past will yield. There are many other motives for a belief in a complete memory record of the past. They need not be recounted here. This question, like the previous one, is insoluble because we have no absolute or complete record with which to compare our subjective memory record. We may, indeed, believe we never forget anything. This does not, however, mean that we can recall everything at will, but only that we cannot be sure that what we can usually specify merely as the event of yesterday or a year ago, or of such and such an occasion, will not return in detail to the mind as the direct object of memory.

3. The Definition of Memory: Distinction from Trace of Influence.

If a series of foreign words is learnt to-day with a certain amount of labour, and relearnt with a less amount of labour after many years of forgetfulness, it may well be assumed that the influence of memory shows itself in the lessened labour of the second learning, although

it must not be forgotten that intervening experiences may be the cause of the saving in labour. So it might be said that every thought and experience we have, has some effect on our minds, just as everything we eat has some effect upon our bodies, and that therefore nothing is forgotten. But this is not the proper meaning of the word "memory." To remember an event is to recall it clearly and consciously to mind with the help of some clue.

4. The Experimental Investigation of Memory.

The knowledge of our time suggests only the attempt to improve the working of memory. We must strengthen in it those influences which favour remembrance, and remove those which quicken forgetfulness. This, of course, has been the endeavour of men of all times. But conviction and system-making have often outrun knowledge, and knowledge itself has been based upon persuasion, effort, and the cursory observation of a few cases rather than upon facts and generalisations, valid in prospect for all, because, in fact, true of so many.

Only within the last few decades have exact observations been made of the conditions which influence the working of memory. Psychologists have begun to investigate memory experimentally. There is nothing new or startling in this. A great many sciences now extend the basis of their knowledge by means of experiment, and all of these knew a time when generalisations were made hastily on a small number of casual and imperfect observations. In the young days of a science such hasty generalisations are unavoidable, because the motives urging to generalisation are at all times strong, and the desire and attempt to form theories is at all times laudable. Such an attempt may lead to renewed care in the establishment of facts already noted, to the discovery of new facts, and so to a better theory. It is not its method of generalisation which characterises modern science, but the demand for an ever-increasing exactness and number of data on which to base generalisations. Modern inductive method demands for its conclusions a basis of observed fact such as is provided either by a few observations under

a limited number of known conditions, or by a large number of observations under known conditions and an accompanying complex of unknown conditions which are all of limited influence, more or less irregular occurrence, and irregular tendency. It is under these latter conditions that psychology experiments. It belongs not to the group of exact sciences like physics and chemistry, which can express laws with mathematical exactness, systematise these and deduce unknown ones mathematically. So far as psychology is quantitative, it is a science of probabilities, based on experimental statistics. As such it has been able to achieve some unity of opinion about the operations of memory and its economy, and so to get rid of the distressing divergence of views which was so general in the previous literature of the subject.

5. Systems of Memory Training.

Where knowledge of the natural basis of any important practice is imperfect, it is natural to attempt to complete it by rules and principles. So we find that well-nigh all the old theories about memory took the form of

systems of memory training, each almost infallible in its own eyes, though differing in many points from any other memory system. There have been systems of all possible kinds, some offering greater, some less results. It is needless to describe them. They are well known. Any pamphlet on the subject will give a good idea of them all. And yet such systems are not all valueless, for, though based on rough trial and general impression, they have been handed down through many centuries, and bear the mark of the experiences of many kinds of men. Thus, both their foundation and their validity may be greater than it seems. But, of course, they were bound to miss many of the influences which affect memory, such influences especially as are too subtle and indirect to force themselves upon our notice. The impressiveness of these systems is derived partly from their seeming simplicity, and partly from the results they describe and lightly promise to everyone, although these are often more remarkable for their oddity than for their usefulness. In principle such systems of memory training

10 ECONOMY AND TRAINING OF MEMORY

are all out of date, although in some cases their contents have not yet been tested or outreached in psychological experiments. Their best effect is to stimulate the will to remember, although they often detract from this by rousing the desire to produce a big show with little substance—in short, how to seem to have a good memory. They have often served a good turn in that they have persuaded many who have followed them that they had, after all, not so bad a memory as they imagined, and so have saved them from themselves. | Most of us are slaves to our bad opinions of ourselves. |

6. Conclusion.

In order to use the memory to most advantage we must first know and understand how it works, which influences increase its power, and which act against it. Our practical efforts must thereafter consist in encouraging good influences and eliminating bad ones. We must therefore observe the memory at work, and measure its activity under varying influences. This is the experimental investigation of memory.

CHAPTER II

THE EXPERIMENTAL INVESTIGATION OF MEMORY

7. The Material.

How can we experiment upon memory ? It is not difficult. We must first obtain material to be learned, and since, in order to derive general statements which will hold good for everyone, a large number of experiments has to be made with different people, our material must be as uniform as possible. Experiments have been made with tones, with colours, with lines of various lengths, and other such simple things ; but experience has shown that the most elementary experience is not necessarily the most suitable material for showing the operations of memory. The use of very simple material is complicated by a variety of conditions which need not be enumerated here.

12 ECONOMY AND TRAINING OF MEMORY

Of all material proposed, the one which most resembles the kind of thing we have to make an effort to remember in daily life is the *nonsense syllable*. It can always be of the same length, and can be constructed according to fixed rules, based on the experimental results obtained by using syllables constructed in various ways. By the use of such syllables, of which great numbers can be made, the very disturbing influence of the meaning of words with their manifold associations can be eliminated from the experiments. It is a familiar fact that words whose meanings are known, are remembered more or less easily for all manner of reasons. Nonsense syllables, having no meaning, provide little attraction to the memory, because they are almost devoid of associations. Thus, then, a large number of series of eight,* ten, twelve, or more syllables can be constructed, of such a kind that the same syllable either never occurs twice or

* Two examples of such a series of nonsense syllables :

Leb, rit, mon, yup, kig, des, wer, zam.

Bax, goul, fos, hiv, ped, vaub, jum, cor.

recurs only after a long interval. So the conditions under which this uniform material is learned can be varied from time to time, and their effect on the rate of learning and the duration of memories observed. It is, of course, not necessary to confine oneself to nonsense syllables. A great deal of work on memory has been done with prose and poetry, and, indeed, the results obtained with nonsense syllables should always be tested and compared with those derived from the use of intelligible material.

8. Method of Taking into the Mind.

Further, a uniform method of taking into the mind what is to be learned, must be obtained. This is usually got by arranging the nonsense syllables or other matter in perpendicular columns on a drum which is made to revolve at different speeds, and before which a small screen is placed. In this screen there is a small slit, through which the learner looks, and in which he sees one syllable after the

other appear gradually or suddenly, and disappear similarly, to be replaced by the next, and so on. The learner attends and attempts according to the instructions given him, which may prescribe silent or loud reading or the like, to learn the sequence of syllables as quickly as possible.

9. Memory Measures.

(a) *The Number of Repetitions.*

As a measure of the rate of learning, the number of repetitions of the series of syllables, necessary before the series can be repeated by heart once or twice, may be used. Under different conditions this number will be different, and will serve as a basis for generalisation, if a sufficient number of experiments are made under the same conditions. So, too, the number of repetitions necessary before the series can be relearnt by heart after a certain interval—say twenty-four hours or a week—will serve as an index of the amount that had been forgotten in the interval. Further knowledge

may thus be gathered. For it may not be taken for granted that the ability to repeat a series of words by heart once, always represents the same amount of mental work. It may be that, tested by the number of repetitions necessary to relearning the series next day, the effort may be seen to be of greater effect under one set of conditions than under the other. By such means a knowledge of the conditions of the most economical methods of learning may be gained.

10. (b) *The Number of Specified Recalls.*

Instead, however, of testing the memory by the number of repetitions which precede a free repetition by heart, the strength of memory may be determined after any given number of repetitions by presenting to the learner one of the words or syllables learned and requiring him to *recall* the one which followed or preceded it in the series in which it occurred, or the like. The number of syllables correctly recalled in this way is then a measure of his memory of

what he had learned. Most valuable knowledge is obtained in this way. For it is obvious that while one may not be able to repeat a series of words quite correctly, one may have retained much of it. Or again, one might be quite familiar with a piece of verse and recognise every sentence and phrase of it, and yet be quite unable to repeat it by heart when given the first line as a clue. If, however, a test were made as to the ability to complete phrases from the piece, to put the right word after a given word or phrase, it might probably be found that a good deal of the verse had been retained. What does this mean? It means that the ability to recall is not the only test of memory. We remember to some extent much that we are not able to recall in its entirety. There is, however, obviously no direct method of measuring the strength of such a memory.

11. (c) *Recall Times.*

The ability to recall is, however, the roughest test of memory, even though some degree of refinement is obtained by counting the specified recalls. But it is well known that two people with equally correct memories may show very different degrees of command of these. One who recalls well, answers promptly. Slow and hesitating answers in which careful deliberation is not involved, are the sign of a much less efficient memory. The townsman, running from street to street every day of the year, talking, discussing, and recalling perpetually, will direct you on your way in a quarter of the time the countryman needs, although the latter has much less to remember in the matter of roads and directions. In school, "Who answers first?" will give the prompt memory its just opportunity. The time, therefore, which elapses between the giving of the question or clue and the first word of the answer, can be used as a good measure of memory. For a complex object of memory, of course, these

recall times in conjunction with the correctness of recall afford a very elaborate and thorough measure of memory. If there is a fair number of short recall times and only a few long ones in a high percentage of correct reproductions, we may call the memory for the complex better than if in the same percentage of correct reproductions there be a smaller number of short recall times and a larger number of long ones. It is evident, then, that one may have a fair memory of a complex of which one is able to recall nothing voluntarily, and a poor memory of a complex of which a fair number of tags remain in the mind. This is one of the reasons why light theatrical pieces appeal to the mass of people more than others do.* Seeing that this method gives not only statistics of

* The simplicity of the lighter piece and the repetition of favourite songs give many details a sure footing in the mind of the listener. The more artistic work, on the other hand, demands sustained attention, is more complex, and often leaves no place for the repetition of parts. It is lovely in its details, of course, but it also aims at producing large unitary impressions, which may often not become quite clear till several hearings and some thought have been spent on the work.

what is remembered, but also time statistics, it is evident that we have here a much wider basis on which to raise generalisations. This method, is therefore much more fruitful in detailed results than the others.

12. (d) *Other Measures.*

There are several other methods by which memory may be investigated. The ability to recognise what has been presented to the mind of the learner once or oftener may be tested. We do not recognise immediately everything we have seen once. There are people who even forget after a short time whether they have read a novel or not. We all know how many a book read after an interval for a second time appears almost new. Unfortunately, however, no very reliable test for recognition is known. A learner can either recall a word or he cannot. He will hardly omit to say the word if he can. But he may say he recognises a word, either without being sure that he does so, or without really recognising it at all. Not

as shown above, may be a good deal. It also omits to record *what might have been recalled*, had a clue been given. Still other methods are possible, but enough has been said to describe the general manner of investigating and measuring memory.

13. Association: Its Definition.

What is the central element in memory which is better in one individual and worse in another, and which may be strengthened or weakened by a variety of factors? It is association. Association is one of the fundamental conceptions of psychology. This conception has been formed to explain the relation of our momentary, fleeting states of consciousness to one another, as forming simultaneous and successive states of a conscious individual who thinks, feels, and acts more or less as a unity. Now, there has been a great deal of trouble in the history of philosophy and psychology over the question whether ideas are independent, self-contained unities, merely linked together into bunches and chains by

20 ECONOMY AND TRAINING OF MEMORY

everyone is equally fitted to be the subject of psychological experiment, and, therefore, where a subject may deceive himself, as we all do unwittingly at times, it is better to hold to methods that can be controlled objectively. Such are the methods of recall already described, and about these there can be no illusion. Another such method of somewhat less value consists in encouraging the learner to repeat what he has learned, even though he cannot do so completely or with confidence. The cues and clues given to him to help him along are then counted, and these numbers form the statistics. It is, however, not very clear just how much help such a clue does give, and the method is, consequently, not of any great value or reliability. Then, again, instead of counting the number of words which can be recalled when each preceding word is given, one may simply count the number of words that can be recalled voluntarily out of the whole complex. Obviously this is a measure of a certain kind of memory, but it neglects all that cannot be recalled spontaneously, which,

as shown above, may be a good deal. It also omits to record what might have been recalled, had a clue been given. Still other methods are possible, but enough has been said to describe the general manner of investigating and measuring memory.

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association, without affecting or changing one another thereby, or whether they influence one another in some way—as, for instance, a red background will influence a grey patch lying on it. The attempt has been made to work out the question consistently from both sides, of course for long without an exact investigation into the facts of the case by means of observation and experiment, and so far, one must say, all attempts have failed, and have often landed in absurdities those who have made them. Material for the solution of the problem is still being gathered, so that no final statement can be made. Fortunately it is unnecessary to venture upon any here, for the conception of association is necessary to a comprehension and analysis of mental states, whether these do or do not affect one another by coming together. There can be no doubt that ideas, whether these be mental images of colours, forms, sounds, tastes, smells, and other sensations, feelings, or thoughts, do get arranged differently at different times, and that a certain amount of mental work, of effort, is necessary to hold

them fast in any one given arrangement. Once brought into any one arrangement, whether by outward impression or by voluntary effort, they tend to remain in it, so that under certain circumstances the recall of one or more of the ideas will tend to bring them all, together or in succession, to mind. Some conception is necessary in order to think about and discuss coherently such arrangements of ideas, and this conception is association. Association is what first makes the reproduction of one idea by another possible.

14. Quantitative Distinction between Associations.

Now, as has been already remarked, we observe frequently that one arrangement or sequence of ideas may be harder to impress on the mind than another, and that certain ideas can be recalled more quickly and with greater certainty than others. Here we find a basis for *quantitative distinctions* between associations. This is provided by assuming that one associa-

tion can be stronger or weaker than another. If one idea is recalled by another, we say the association between both is stronger than it would be if the idea could no longer be recalled. If one idea recalls another more quickly in one case than in another, we also say the association is stronger in the first instance, and so on.

15. Problems Stated.

Now, what makes an association strong or weak? This is just what the experimental investigation of memory must try to find out. What influences determine the strength of an association? Under what conditions can the strongest association be produced with the least amount of effort in the shortest time, and what will secure the recall of an idea at the most appropriate time, and at any desired time? We shall proceed to enumerate these factors directly, but before doing so one or two general questions must be discussed briefly.

CHAPTER III

SOME GENERAL QUESTIONS

16. Is All Memory Mechanical ?

Is there such a thing as a purely *intelligible memory*, or does all memory rest on the *mechanical* basis indicated in the last chapter ? The general tendency at the present time is to hold that memory rests on a purely mechanical basis, that certain connections have to be made, and that there are certain conditions under which such connections are made strongest and most lasting. A good memory means, then, either the capacity for very strong associations, or the natural or acquired habit of producing the strongest and most lasting associations with the least labour. The question is of interest to the teacher. The answer just given does not mean, of course, that in learning a piece of verse, for instance, it is necessary only to get

up the words parrot-like without minding the sense. We shall see later on how wrong this is. It means that, however many thoughts are brought together, the necessity of acquiring the sequence of words by means of association of one word with the other will never be removed. On the other hand, these associations may be formed more rapidly by means of the ideas with which the words are already firmly connected in the mind—that is, by means of their sense. The thoughts of the verse, then, serve to bind groups of words together easily, and to unite these groups into a whole. Any ideas introduced into the verse beyond what is suggested or made necessary by the verse itself, will not reduce the work to be done in forming the required association. They will, if anything, increase it by the amount of memory work to be done in linking the superfluous ideas to words which do not suggest them, and one another, and then in getting rid of them. For if the verse is to be learnt properly, fluently, they must be got rid of. If by the sense is easy, because the

between the words and their sense have already been made, and it would mean more work to bind the mere words together by association than to associate their sense in its already developed form—complex thoughts. Yet the association between the word and its sense is in itself a mechanical one—that is, it is itself merely an association; there is no intelligible intermediary binding the sense to the word. Any word could mean anything. This means that only the association with a meaning gives a word meaning. All memorising rests, therefore, ultimately on a mechanical basis, whether trains of words or thoughts be memorised. Whether there is not also some form of intelligible memory, more especially in the sphere of thought, remains to be seen. Thoughts certainly do bear relations to one another other than those of mere contiguity or succession in the mind. Possibly these relations might under certain circumstances fulfil functions analogous to those of memory. If so, we shall find out about them in good time.

17. Has the Child a Better Memory than the Adult ?

There is a very widespread popular opinion which says that the memory of the child is *stronger* than that of the adult. Evidence of this is the fact that the child learns a language in a few years—a feat which a large number of adults feel to be beyond their power—not to speak of acquiring the accent properly. See how quickly the child retains small verses and fairy stories, and how ineradicable the memories of childhood are, even in the last years of the longest life. Our memories must have been stronger when we were young, we think. We rarely learn a verse of poetry now. We forget the contents of a novel in a month or two, if not in a day or two, after we have read it ; and as for remembering the past, why, it is often hard enough to remember what we did yesterday. Against all this, however, one may put the fact that we remember far more of the scenes of the year just gone than the child does. Moreover, the child learns very little of his

language in the first few years, and any adult of average intelligence who might be surrounded by as much careful attention, and taught so persistently and carefully as the child, would learn in the same time far more than the child does. The child, however, has in so far the advantage, as his mind is unoccupied. It is to his ever-increasing advantage to learn continually, and he has little to forget while doing so. On the other hand, the adult is settled in life; he has adapted himself to his surroundings, and usually does not want to learn anything new. As a matter of fact, it is not true that our memory is strongest from the first few years of life up to about the tenth or thirteenth year, and then begins to weaken. This has been proved by experiment. The same tests have been put to young children, school-children, and boys and girls up to the age of twenty, and these show that the older the learner, up to these limits, at least, the quicker he learns and the better he remembers. It may, of course, be that the child does not know how to learn to advantage. On the other hand, he prob-

ably does not go far wrong of his own accord. Yet, even if he did, he would certainly not learn so quickly or so well as the adult. He cannot concentrate his attention so closely nor for so long a time upon one object, and he has not the experience in thought to work upon which the adult is generally supposed to have. The will to learn and to remember is doubtless the most important of all influences in this regard. Every grown adult who keeps his mind mobile and is not suffering from weakness or disease, has as good a memory as ever he had. The trouble usually is, that we are either hypnotised into inactivity and lack of enterprise by our own poor ideas of our powers, or by such ideas instilled into us by the countless thieves of souls, who go about the world telling people what they are at least not good for, helping them to overcome the difficulties of choosing a career in life by cutting off the possibilities. The experience of the earliest experimenter on memory has shown how much even passing opinions of one's power, and of the quality of the work one is doing, will affect the progress

of that work. The rate and permanency of this psychologist's memory-work varied from day to day as his opinion of it. How much more, then, will not a strongly rooted idea of inability for any one kind of work lessen the progress of such work in spite of strong will to work, if it does not weaken the will which keeps one going ?

. . .

18. Does Memory Run Parallel to Intelligence ?

On the further question, whether memory goes hand in hand with intelligence, opinions differ. Some find that the cleverer boy has usually the better memory. We all know that most clever people have a good stock of ideas. But we often find a clever man who complains of having a bad memory. Now, in so far as reliable statistics have been gathered, it has been found that the greater intelligence is usually accompanied by the better memory. There are, on the other hand, mentally afflicted people who have quite an extraordinary memory for words, and who have practically no intelligence at all.

A good memory for facts is becoming less essential to intelligence of moderate or even more than average degree, than it used to be. Instead of collecting facts in one's head, one may, of course, equally well, though with much greater labour, collect them on paper. It is done to an extent undreamt of by many for every great work, just as it is done to such an extraordinary extent in business to-day. On the other hand, the collecting of many ideas in one's head is also a work of memory, just as much as the committing of strings of words or verses to memory. Moreover, too good a memory is not favourable to great intelligence. The mind gets cramped with the overwhelming mass of facts. General ideas and explanatory ideas do not occur so readily, because of the difficulty such a mind finds in abstracting from the full concreteness of the facts, and in seizing the essentials in any complex. Men with extraordinary memories tend to lose the ability to judge critically. They have often found *great difficulty in understanding mathematical proofs*. The highest type of mind, of course,

combines the faculties of vivid and detailed memory with that of keen critical judgment. Its execution is brilliant, while its comprehension is deep. But a good memory for groups of words, sounds, or the like, does not go hand in hand with good intelligence. Some evidence, too, has been gathered of late, that memory of thoughts is governed by laws different from those which regulate the memory for sequences of words and sounds. It has not yet been made out clearly, however, what psychological factors are involved in what we ordinarily call intelligence. But we may safely say that they are not identical with, nor dependent on those which have so far been found to be the basis of a good memory.

19. How Much can be Done by Mere Effort of Attention ?

It has often been supposed that a mind with a good *memory* is distinguished from other minds by the energy with which it can concentrate its attention on the matter to be committed to memory. A great many people

believe that *concentration of the attention* is everything. There is in each student's life a time when he goes in for "concentration," and comes out each time with a headache, and in the end is not much the wiser. If he is fortunate, there is in his life another period in which he finds the hours fly by on wings, and every subject and every book distressingly interesting. He finds it hard to get on with his work because he finds everything else so attractive. If he comes out of this period, he may find a subject so absorbing that he forgets time and his other interests over it. There is now no need to concentrate the attention. It concentrates itself, and him too. One might even make it a rule for those who wish to cultivate the power of attention, to guard against thinking about their attention at all, and to get interested in some subject or the subject in hand. At a recent congress a gentleman with a remarkable memory allowed himself to be demonstrated to the assembled company. One of his performances was to learn a series of three hundred figures by heart in fifteen minutes

or thereabout, and say them backwards, forwards, up and down, any way, at the end of the time. In the discussion which followed it was suggested that the gentleman accomplished this wonderful feat by one determined and extreme act of concentrated attention. But nobody knows exactly what attention is, and everyone has a different theory about it. To try to *explain* anything at all with the help of such a conception, is out of the question. We must try to explain the working of memory by means of the factors which are known to operate on it, and to discover any others with which we are not yet acquainted. People know, of course, what you mean when you tell them to be more attentive. To be attentive means to give oneself up more exclusively to one thing at a time and to one thing for some length of time ; but every state of attention is brought about by some definite influence working on the thinker.*

* Attention is thus rather a long-continued activity or state of mind than an influence capable of producing definite changes in the mind, as, for example, an intention is.

Attentiveness never occurs spontaneously in the absolute sense of this word. It may occur in an individual without any stimulus from without him, but there is always a cause for its occurrence. The temperature of the skin may rise by the influx of heat from the surrounding air, as, for instance, on a hot day; or from within, by changes in the organism itself, as, for instance, in a fever or during muscular activity. But the temperature never rises entirely without cause. There is always some influence present, in whose absence the increase of heat would not take place. In the same way there is no such thing as spontaneous combustion. There is, of course, what is called spontaneous combustion, as when a mass of oil takes fire "of itself" (above a certain temperature). But no chemist would think of this as spontaneous combustion in any absolute sense. So in psychology there is nothing that happens in the mind—no change of thought, or will, or feeling—but has its determining condition, although a great part of the workings of the mind may certainly be occasioned

by preceding events in the mind itself. Our actions are often influenced by our preceding feelings and thoughts, and what we call choice is an event which is essentially dependent on preceding thoughts and feelings. One may certainly do as one likes, but that does not signify action without a cause, but action determined by a limited set of feelings, or by the thought of doing the opposite of what one might have been expected to do. It is possible, of course, to allow action to be determined by impulse, or by the promptness and importunity with which the one or the other course offers itself to the uncontrolled mind. So, when asked "Right or left?" "Heads or tails?" one may choose according as the one or the other word gets to the tongue first. But there are definite causes which decide this, too, as can be proved by psychological experiment. So, too, with the idea of attention. According to our present knowledge, there is no unitary cause which produces the effect known as the state or process of attention. It does not seem at all probable either, that, when psychologists

have done with finding out what factors influence attention for good or bad, there will be left any unitary process or anything at all which could be called attention. Attention is a popular name for a complex of states or processes of mind.

20. Memory and the Energy of Mind Available. . . .

Nor must one think that the mind has at its disposal a certain amount of energy greater in one man than in another, or greater in the same person at one time than at another. The energy at the disposal of the mind is, as in all other manifestations of energy, dependent upon the amount of energy which is let loose by the factors operating at the given moment. The operations of the mind are limited in their degree only by the intensity and number of the influences working on it, and by its own carrying capacity. We know only vaguely the commonest actual limits to its power. We know practically nothing about the limits of

its possible power. As a matter of fact, we observe differences in mental power from person to person, and more so from animal to man. The evolution of mind already realised suggests the idea of developments which we, of course, are not in the least able to foresee—developments which will raise the human mind much farther above its present state than it is at present above the *mind of the higher animals*.

CHAPTER IV

THE FACTORS WHICH INFLUENCE MEMORY

21. Immediate Memory.

THERE are things which are learnt as soon as heard. A spoken sentence, a friend's address, a series of half a dozen numbers can be repeated after one hearing. Such impressions leave behind them full and clear memory pictures which endure for some little time. If words have been spoken, we still bear in mind our friend's voice, and may even be able to imitate his pronunciation exactly. This kind of memory is often called immediate memory. The power of such immediate memory differs slightly in different people, and especially amongst children. Apart from the general ability to retain sounds or colours, which varies a good deal, the power of immediate memory seems to be dependent on the momentary

strength of the motives to remember, and on the absence of distraction and excitement in the learner. It is also easier to recall a series of words or numbers, a certain number of seconds after the last one has been uttered, than before this or later. The successful repetition of such a series of numbers gives a feeling of satisfaction which, if the series is just at the limit of its length, is sharply contrasted by the feeling of confusion and helplessness which supervenes when reproduction fails. At a certain point the learner's hold on what has been heard, seems to relax completely, and he sits in confused silence, or murmurs incoherently.

22. The Number of Repetitions.

Longer series of words or numbers are committed to memory after several repetitions, and in general, within the limits of ordinary practice, the greater the number of repetitions, the stronger is the resulting memory of the matter learned. Beyond a certain point, however, an

increased number of repetitions brings no advantage, but produces only headache or a feeling of stupidity. Provided there has been no change of pronunciation or intonation from time to time, the mental picture derived from a number of repetitions may be just as clear as that derived from only one. One can, for example, remember distinctly all the sound changes in a recitation learned from the phonograph. But if a living voice, with its continual change of tone and manner, repeats the matter to be learned, it is obvious that only the general effect of all the readings will be impressed upon the memory. The final sound-picture in the mind will be made up of a number of features of greater or less distinctness, whose character will depend upon what the learner specially listened to, and what for any reason was impressed upon him more vividly from time to time.

23. The Shortest Association is the Strongest.

The general effect of a number of repetitions is little by little to increase the strength of the association between one word or number and the following. That such an association has been formed is shown by the fact that a series of words, too long to be recalled, is very often, on a second hearing, at least recognised as having been heard already. Each repetition serves to strengthen these associations, till the presence of the first member of the series enables the learner to repeat the whole series if he wishes to do so. It has been found further that associations are formed not only between each word of a series learnt and the next, but between each word and the second next, the third next, and so on. The strongest association is naturally that between two successive words of a series—the *shortest* association, so to speak. The longer an association—i.e., the farther apart in time the ideas are which it connects in the mind, the weaker it is. Thus,

each word brought to mind prepares a number of those which follow, so that the association which serves to recall each word gradually increases in active power until the actual moment of recall.

24. Some Helps and Hindrances to the Formation of Correct Associations.

Now, it is obvious that, in order to learn any sequence of ideas correctly, it will be necessary to form the proper associations between these ideas. They must be strong enough to excite each other in the proper order. If, for any reason, the association between one idea and the second one following be stronger than that between it and the first following, it will in all likelihood recall the second one rather than the first. The second idea will thereupon recall the third and the fourth, and so on, and one idea, a word or a sentence, as the case may be, will be omitted. Care must be taken, therefore, to keep what has to be learned in its proper order. It is well in learning anything to read it over

very carefully, more especially the first time. The *first repetition* is known to contribute more towards the formation of associations than any succeeding single repetition. The first repetition must be correct: not only must the sequence of words be correct, but it must be as correct as possible in every essential detail, pronunciation, and the like. It is advisable further to avoid the attempt to recall from memory alone, without looking at the matter to be learned, until some confidence in recall is gained. It is especially during these *efforts to recall* that the varying strength of the associations formed is of most decisive effect. For one reason or another—perhaps because a certain word is more familiar, or has been already associated with another, or because one has looked from one word to another in the page several times—some associations are often stronger than the one which should operate at any given moment. A word is then recalled out of place, and every time this happens the false association becomes much stronger, the more so if it is not at once corrected by a glance

at the book. Every halt or doubt ought to bring the learner's eyes at once to the book. A wrong association is very hard to eradicate. It introduces an element of competition into the working of the associations, and if a wrong association has become powerful enough to recall its word, the consequence will be that, in order to repress it, the correct association will have to be worked up to much beyond the strength necessary for the reproduction of its word, had no false and competing association been formed. To make the correct association compelling, it will have to be raised to that strength which will enable it to reproduce its word more quickly than the false association can reproduce its word. This means a great deal of useless and unnecessary labour. All rival associations—that is to say, all associations which may become active under the same conditions and at the same time—hinder or block one another. The typical and normal form of all stable nervous action is that in which only one idea or action takes effect. All rivalry means great waste of power.

25. Inferences.

A number of inferences may be drawn from these facts. It is better to learn slowly than to learn fast, and in so doing run the risk of learning a great many errors. This is especially true of learning languages. Many people attempt to converse freely in a foreign language before they have the necessary grammatical and syntactical knowledge. The result is that they either never, or very slowly and with great effort, eradicate the errors to which they become accustomed. Children who are acquiring knowledge ought to hear wrong statements of fact as seldom as possible, even although these may be corrected at once. Of course, where reasoning is involved, the *demonstration of the falsity of a statement* is quite a different mental process, and does not necessarily make the truth any less convincing or evident. Further, hesitation being a sign of a momentary weakness of recall, a child who hesitates usually should not be allowed to give a wrong answer. The teacher should let

another child give the correct answer, or himself give it. By giving a wrong answer the child does a good deal to make the learning of the correct thing more difficult. By giving the correct statement at such a moment of hesitation one may, on the other hand, just win the victory for correctness of recall in the child's mind. For the same reason all guessing should be forbidden. Not only does it make wrong associations, but it also discourages the attempt to remember. One of the evils of attempting work that is beyond one's power consists in the number of wrong ideas and methods acquired. It need hardly be mentioned that children had better be trained to do what is right, than not to do what is wrong.

26. Learning in Whole or in Parts.

(a) *Familiar Matter.*

Now we have seen how to carry out a series of repetitions a further question arises: Is it advisable, in memorising a piece of some length, to learn it bit by bit, or by reading it through

from beginning to end each time? Ordinary experience is agreed that it is better to learn little by little. It would hardly occur to anyone in learning a hundred lines of verse to read the whole hundred through time after time till they had been committed to memory. The learner begins with the first set of lines which form a unit, and commits these to memory; it may be by repeating the first two lines till he has them by heart, then, stitching on to these the third and fourth lines, gradually working up to the first eight, and so on till the whole set of lines is learnt. These he repeats once or twice till he has them well under control, and then, if he is not tired, he learns the next section, and so on. A great deal may be said for this procedure, which practically everybody follows. Curiously enough, the results of experiments have shown that this method is by no means economical. It has been found that a piece of poetry can be learned with fewer repetitions if it is read through as a whole at each repetition than if it is learned in bits. Nor is it hard to make this result plausible. Think of

the number of false and useless associations formed by learning in bits. Two lines are repeated several times, and at each repetition an association is formed between the end of the second line and the beginning of the first. Then the third and fourth lines are treated in the same way, the end of the fourth being linked up to the beginning of the third. When the two pairs are connected, we have a new association between the second and third and the fourth and first lines, both of which compete with already formed associations. It is obvious that if this is continued all through the piece *the mass of associations formed becomes very complex*, while only a small number of those formed are ultimately of use. All the others are so many pitfalls. If 100 lines of verse were learned in this way in twos or fours—say, verses from Pope—there would be formed between the lines 198 or 148 associations, of which only 100 would ultimately be required. Every second one of these would be blocked by two useless associations, and in order to be safe from their power would have to be raised to a

much greater strength than would otherwise have been necessary. In time the strength of all the associations formed would decrease, and those necessary to correct repetition of the verses, being in many cases formed later than the false associations, would lose strength more rapidly than these. Thus, in the end many of the false associations would be the more powerful and therefore effective. For this reason many people find that what they have learned they can recall fluently up to a certain point, but that everything after that is a blank, except the beginning of the piece or the beginning of one of the verses before the point of breakdown. If such a calamity is to be avoided, study should as far as possible consist in continued revision or repetition of the whole performance. It is worth while repeating the whole many times for the sake of the part, if the stake is great. Even little children may with advantage learn their little sets of verses by reading and repeating them time after time straight through. Just think how well they will remember a fairy story, which they so seldom hear or read in instal-

ments, and which they will hardly suffer to be broken off, however often they may have heard them before.

27. (b) *Matter with Special Difficulties.*

But must the whole piece be gone through always? Is there no exception to this rule? Suppose there were some particularly difficult point in the piece, would it not be better to practise it separately till it was mastered, and then to learn the piece as a whole? It seems clear that many repetitions would thereby be saved. Trial has confirmed this. Of course we are already familiar with most words of our mother-tongue, and in learning poetry, for instance, we may with advantage learn by repetition in wholes. But if it were necessary to get up a series of words of a language we do not understand, it would be better to make ourselves acquainted first with the single words or syllables by repeating each several times over, singly, or in twos or threes, and at increasing speed. So we accustom our tongue to their

pronunciation, our ear to their sound, and our mind's eye to their look. In other words, technique must be acquired largely by itself. We must concentrate the attention upon it in special study till it is mastered. Then, when we meet it in the course of some piece of work, we shall not be brought to a stop by it. So the mind will be free to absorb what is embodied in the larger build of the piece in hand. This is one reason why technique is made a matter of special study. Familiar matter, then, may be learned as a whole; unfamiliar matter must be studied bit by bit, even at the risk of false associations, until it becomes familiar. The learner need not be told what is familiar matter and what not. Let him be guided by his feeling. If he finds any part specially difficult, let him study it by itself first. Then let him learn it with the piece in which it stands, and as a subordinate element in this piece.

28. (c) *Very Long Pieces.*

Suppose, now, a thousand or ten thousand verses were to be learnt by heart: how would it best be done? Sit down and read through the ten thousand until we had them off? Who could endure this? A few wrong associations do not matter much. We can tolerate them, and devote a little time to driving them out afterwards. We must come down to the level of human power, and encourage the will as much as possible. This we do by gratifying the impatience of the learner, and by encouraging him to conquer slowly. A moderate number of lines may be learned each time. Their acquisition will gratify the learner, make him partly independent of his text, and give him food for thought. And thus in small stages he may work towards the great accomplishment. This is no doubt largely responsible for the general habit of learning in fragments. But for those who know that the method of learning in wholes is economical, and have energy to go on with it as far as they can, there is no

need of such a stimulant. Of course, where the work done in committing anything to memory is very small compared with the study put into it after the memory work is complete, it does not much matter by what methods the memorising is accomplished. Memorising is, then, not the aim of the work, but an unimportant incident in its course.

29. The Distribution of Repetitions.

We are often called upon to remember things—*e.g.*, music, verse, speeches, trains of facts and ideas—which may have to be repeated very many times before they become permanent possessions. Is it better to learn as much as possible at one time, or ought one to learn a little one day, a little next day, and so on? Such a question, of course, we cannot decide on the basis of general and unsystematic observation and inference, but only by experiment. One of the earliest experimenters on memory tried to decide the question in the

following manner : He learned a lengthy piece at one sitting, with just seventeen consecutive repetitions, and thereafter recited it fifty-one times ; next day relearnt the piece, with seven repetitions, holding the difference to be due to the memory effect of the first day's work. This he compared with the number of repetitions necessary to relearn a perfectly similar piece of matter which had previously been repeated thirty-eight times during the course of three days—for instance, seventeen times the first day, twelve times the next, and nine times the third day. He found that more repetitions were needed to relearn a piece after the one set of sixty-eight repetitions than after thirty-eight repetitions spread over three successive days. This first fragmentary result was worked out more elaborately later, and it was found that *the more the repetitions are distributed over a series of days, the stronger is the memory in the end, and the fewer repetitions are necessary, on the whole, for relearning.* For instance, of the three following arrangements—three sittings of eight repetitions each, six of four, and twelve

of two — the last is the most favourable to learning; in other words, fewer repetitions will be needed to learn, more will be remembered, and this will be recalled more quickly. It is better both for learning and for remembering to spread the repetitions over some time.

30. Inferences.

What does this mean? It means that in *committing* anything to memory not too much work should be done at one time. Of course it would not do to be guided only by the consideration of the number of repetitions, otherwise one's work would be spread over too long a time; the helping element of interest might be weakened, and annoyance and disgust might even arise. There are many kinds of matter which it would be more satisfactory to learn with considerable effort during a few sittings than with much less effort during a dozen or two dozen days, each bringing its small dose of monotony. But in general it is

better not to do much of the work of committing matter to memory at one time. For instance, if poetry is to be learned by heart, and sufficient leisure is allowed, it should be read over *carefully a few times at first, with close attention to meaning and interpretation*. When these have been exhausted, it should be repeated till it can be said by heart once. Then, if the work is put aside for a short time—a day or a number of hours—and any attempt to recall it during this interval is *carefully avoided*, in order that the somewhat unstable associations may not be confused, probably one or two more readings will then suffice to insure its correct repetition by heart any number of times afterwards. On the other hand, if the number of readings is pushed too far the first time, the learner is liable to become confused and depressed, and to increase the final labour of learning by making errors.

There is no need to despair if, shortly after the end of the first set of readings, nothing of what has been learned can be repeated. The attempt to recall is itself harmful. Let the

work be resumed quietly once or twice, and the memory of it will grow gradually, and be strong in the end. One of the reasons why so many people think they have a bad memory is because they have found themselves unable to make a permanent record of any matter at one sitting. Being led to a brave effort rather, perhaps, by emulation of others than by the love of remembering, they are discouraged by their failure to recall what they had learnt so well and hard the day before. They are then convinced they have no memory, and determine not to try again. Had they come back to their task once or twice, and not exhausted their good-will at the first, they would certainly have succeeded. Any ordinary person can learn anything if he will only go about it in the proper way.

31. By learning several things by heart simultaneously, interest and impetus in work can be attained, while the greatest economy of memory is secured by wide distribution of repetitions. Suppose three pieces of verse or

divided so as to save most labour, the teacher or learner will for some short time get little or no conscious return for his work. More emphatically, he should get no return in the early periods of work. Not till some time has elapsed will actual recall, and still less imaginative or creative production, be possible.

Abilities which rest upon the experience of months or years are also only slowly acquired. Ready command of a language, or of a game like golf, the mechanical fluency of type-writing or stenography, and ripe general experience itself are all preceded by a long period in which no advance, but rather the contrary, seems to be made. This is a necessary result of the fact that in these complicated activities many situations recur only at somewhat long intervals. But in good time the learner assumes command.

chapters of facts are to be learned. Let the plan of work be as follows :

<i>First Day</i>	2 or 3 repetitions of 1st piece		
Followed by	2 " 3	"	2nd "
"	2 " 3	"	3rd "
<i>Second Day</i>	2 " 3	"	2nd "
Followed by	2 " 3	"	3rd "
"	2 " 3	"	1st "
<i>Third Day</i>	2 " 3	"	3rd "
Followed by	2 " 3	"	1st "
"	2 " 3	"	2nd "

and so on, till they are acquired. Such or similar procedure is suitable for any kind of memory work, whether it be verses, spelling, geography, dates, or any other mainly associative groups of facts. With this plan of work, however, one must remember that it is not good to try to recall between days. Nor, if teaching by distributed repetitions, should pupils be tested until one feels sure that the most of them will recall correctly. Then those with better memory should be tested first. Their correct answers will serve as extra repetitions for those whose memories are less nimble and tenacious. In conclusion an interesting inference may be noticed. If the work of learning has been

divided so as to save most labour, the teacher or learner will for some short time get little or no conscious return for his work. More emphatically, he should get no return in the early periods of work. Not till some time has elapsed will actual recall, and still less imaginative or creative production, be possible.

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32. Old Associations Lose Strength less rapidly than New Ones.

The discovery of the effect of the distribution of readings leads to the important theoretical statement that an association which

has been formed by repetition or any other means decreases in strength rapidly at first, more slowly afterwards, and then hardly any more. For if associations lost strength gradually and proportionately to the intervening time, it would not make the slightest difference whether readings were accumulated or distributed. The result would be the same both ways. Now we have noticed how, even when the best methods are used, the various associations within a piece which hold it together in the mind may be of very different strength. Some may at first have been wrongly formed, and in order to force them into line, may then have received exaggerated encouragement. Others may have had to be specially practised to become easy, and so on. It is therefore obvious that complete and correct recall now is not a guarantee of such recall at any future time. How, then, shall we know if what has been well learned has become a permanent possession of the memory? The answer may be inferred from the above rule. Time will show the weak members. After the piece has been

brought to a state of correct and fluent recall, it should be left completely alone for a week, a month, or three months, according to circumstances. Then let its recall be tested entirely without warning or preparation. If it is still correctly and promptly recalled, it has become a more or less permanent possession of the memory. All the weak points in the work of learning will show themselves in the inability to recall, in hesitations or slight pauses in recall, or merely in a feeling of uncertainty as to correctness. Correct and sure recall ought to bring with it the assurance of its correctness. To make learning complete at this stage, if it be desirable, the piece should be repeated several times, and special attention given to the weak points revealed by the test.

33. The Persistence of Ideas.

With the help of one of the methods of recall, it has been shown further that not only associations, but even ideas themselves, gradually fade from the mind's view. Our mental im-

pressions do not disappear at once, but for the first few minutes after their origin they are in a state of strong but quickly decreasing activity. During this time they are still stamping themselves upon the mind, and producing stronger associations with one another. Such a persistence of ideas is well known. Experiences leave their impression, as we say. Only after some time are we able to drive them from our mind, and it may very often happen that they reappear there time and again, in spite of our desire to be rid of them. Seen in such light, this habit which impressions have of persisting in the mind may seem to be a very undesirable one. But it brings with it many advantages. For one thing, it means that the process of learning does not cease with the actual work of learning, but that, if not disturbed, this process runs on of itself for a time, and adds a little to the result of our labours. It also means that, if it is to our advantage to stand in readiness with some word or thought, we shall be able to do so, if only this word or thought recur to us but once, some time before the critical

moment. So we remember to keep a promise, to pay a call, to make a remark at the proper time, even though we turn our mind to other work or talk for some hours between. We can do this, because, if not vigorously prevented, ideas and words keep on reappearing in the mind. People differ very much in this regard. There are persons whose ideas persist and recur so steadily that they never fail to remember engagements and duties at the proper moment. Others are much more forgetful, as we say. And yet many a person who is accounted forgetful has a much more tenacious and systematic memory than one who forgets no engagement or intention. Strong persistence of ideas shows itself in the difficulty many people feel in turning their mind to a new piece of work. The work just finished will not loosen its hold on their mind quickly enough. So the weary work of mending broken fragments of an argument may steal an hour from sleep. Many people dread any serious interruption in work, not because of the time lost, but because it is hard for them to pick up the thread

of their work again owing to the persistence of ideas foreign thereto. On the other hand, there are many who find no difficulty in falling asleep immediately after hard work, and who can answer a question or see a friend in their working hours without any inconvenience.

34. A Pause after Learning.

It is important that nothing be done to weaken the persistence of ideas which follows the process of learning, for we should thereby waste a part of our efforts. To remove some unpleasant impression from the mind, however, we naturally turn the attention vigorously to some other subject, and so weaken the hold of the unpleasant ideas. On ceasing the effort to learn, therefore, it is not advisable to turn the mind at once to another subject. It is better to allow it to rest for some five minutes. Let it wander as it will. If a number of unconnected facts have to be learned, do not crowd one after another in quick succession upon your mind, but take them quietly and slowly, giving each time to settle into its place.

Of course it is hardly necessary to remind the learner that any memory work done while the mind is fresh is much more likely to be of service later than work done in a state of fatigue.

35. Learning with Periodic Pauses.

It is not merely the engagement of the effort to learn and the formation of new associations which, by preventing the learner from thinking of what he has learned, lessen the efficiency of associations just formed. It is rather the presence of any mental activity quickly following another that is injurious. Even looking through a book of commonplace pictures will lessen the effect of any preceding memory work. In the hope of benefiting by this fact, the experiment has been made of introducing into the course of learning, pauses of such a length that they would not materially interrupt the formation of associations. This was found to be of great advantage. Pauses of about a second's duration or more, according to the circumstances, refresh the mind, give it

a short breathing-space, as it were, and increase the speed of memorising and the duration of retention. *The simplest and most elaborate styles of speaking and writing are governed by this need for periodic rest. They relieve the mind of the speaker, and give the listener time to grasp what has been said. A full stop is very often more helpful to the reader than a conjunction, just because it allows of a short pause, over which the associative activity of thought springs more easily than it would if supported by "and."* Even poetry is to some extent characterised by periodic rests. When a series of syllables is learnt by heart, it is found that, first of all, those at the beginning and the end of the series cling to the memory, and that the series gradually closes up towards the middle. When a short pause is introduced into the *middle of the series, the bridge has two spans: it starts to grow from the beginning, from the end, and from the middle in both directions, and closes up at two places simultaneously. Each pause is a point of early growth. The more of these there are, with due regard to*

the nature of the work, the sooner is the bridge complete.

36. Rhythm.

Poetry makes use of another very powerful support to memory—namely, rhythm. Rhythm is a most important element in all kinds of mental and muscular activity. Work is notoriously much easier if a rhythm of work is given. The workmen on the street hammer in a rhythm because the necessary muscular effort is then made much more mechanically. It is excited and liberated, not by a conscious effort of will, but by the sequence of hammer blows, which almost reflexly releases the required impulse. Migrating birds take their turn in the van. They make pace for the others, just as is done on the racing-track. It is much harder to produce an acceleration of work voluntarily than to follow with one's efforts an accelerating rhythm given by another. Rhythm is also a powerful aid to memory. It forms an extra association between the varied stress it brings and the syllable so stressed.

and so binds the whole more firmly together. Rhythm eases the course of recall and makes it more fluent. On the other hand, distinct injury is caused to the memory of anything once acquired when it is relearnt in a different rhythm. To change the rhythm is like learning a new thing, and relearning under such circumstances entails much more work than relearning usually does. But we naturally fall into the rhythm of anything written in our own language, and we have a natural tendency to impose rhythms on all our mental and bodily work. Rules are therefore hardly needed. The rhythm suitable to what is to be learned should be adhered to strictly, of course. Where there is no such rhythm, the learner may impose his own, but let him hold fast to the rhythm he selects.

37. Learning under Pressure.

Let us now consider the case in which only a limited time is available for committing a piece to memory. Is it better to repeat the matter to be learned as often and as fast as possible,

or should one read it slowly and carefully ? In answer to this question, experiment has shown that it is better to read fast, though not so fast that clear pronunciation and clear grasp of the sense of what is being learned becomes difficult or impossible. The young pupil who has left himself little time to prepare his lesson commits it to memory at the highest possible speed. But as fast as possible is not always best. There are two most favourable rates. One of these is a good deal faster than the other, and is specially suitable when the matter to be learned is familiar, and when the learner is quick in speech and action, or accustomed to learning mechanically, without conscious deliberation. The other is more suitable when the matter is unfamiliar or difficult, and when the learner is one who works slowly and thoughtfully. Such a learner often forms rational connections in thought between the successive elements of what he has to learn. With the slower rate, he has time to recall these supporting ideas, which in turn give him a feeling of security

and confidence in his memory. The main disadvantage of reading very slowly is that there is time for all sorts of irrelevant thoughts to slip in. These do not necessarily support the associations formed, and have ultimately to be driven out. In general, it is well to suit the speed of reading to the matter in hand, which in all essentials must be fully grasped and understood. So it becomes clear that increase of speed is merely the means by which the mental energy is concentrated upon one end. It does not of itself produce more lasting memories. Of course, when one is learning diligently, the rate of repetition and complete acquisition increases the nearer one approaches the point of free repetition by heart.

38. Localisation.

System is an aid to memory. Each word learned is associated with its place in the system, and can be recalled at the proper time by means of this association, which is usually strong, easily formed, and unambiguous.

Localisation in a scheme also makes it possible to recall any definite word directly, because of the association of the word with its position among the others—that is, with the image or the number of the place in which it stands. So advantageous is this association, that one of the most ancient systems of memories was based on it. Simonides was accustomed to associate the number, names, or topics he wished to memorise with the different rooms of his house, or with the furniture of each room. On letting the familiar plan of his house and of each room pass before his mind, he could easily recall what had been associated with each part. In this method many modern systems of *memory training* have followed him. Localisation is a greater help to the memory with somewhat unfamiliar matter than with familiar matter. Number forms¹ and schemes are found only among those who experience some difficulty in working with numbers. To the ready calculator numbers present themselves not in a curve picture or as a circle or a zigzag, but directly as printed or spoken

symbols. To him, again, all extra associations and aids are an encumbrance. Localisation is naturally of greatest benefit to those who visualise well. They retain in their mind's eye a distinct picture of what they have seen, and with a little effort can recall it so clearly that they can read from it as from a book. Beginners and children often find it helpful to see new words and terms written and explained in a certain plan. There can be no doubt that one of the reasons why poetry is so easily remembered is its neat division into a series of lines lying one below the other. A good arrangement helps the mind to grasp and remember a discourse, an argument, a description, in fact, almost anything. But it must not be forgotten that there are people who hardly visualise at all. Their mental pictures are either very limited and faint, or they do not have such things. Such people will gain little from pictorial localisation, though it is possible that it may aid them in other ways, as, for instance, by the association it brings with the name of the place in the

scheme, by its acoustical arrangement in a certain sequence, by the mere thought of its place, and so on.

39. The Will to Remember.

The experimental work on memory has shown one very important thing—namely, that the will to learn has an enormous influence on the amount that can be learned and the speed of learning. It is one of the most important factors in the process of learning, and will do more to increase the actual work done by the memory than almost any other factor mentioned up till now. While attention to the other rules frees the memory from many influences which weaken its strength and blunt its accuracy, it is the will to remember which frees it from its own inertia, and gives it active power. Most people are unaware what their memory will do, if it is only put to work. Actual experiment has shown that the most astonishing results can be obtained by the mere effort of the will to memorise, quite apart

from all tricks and memory systems. One reason for our belief that in childhood our memory was much better is probably the fact that we were then under school discipline, and were drilled to effort by periodic examinations. When pushed by the results of our own negligence, we could easily cram the work of weeks into a day or two. Afterwards, when the motive or compulsion to exert the will in this way is gone, we tend to imagine that our memory too is gone. It has often been noticed that things may be read or repeated an indefinite number of times without being committed to memory, if only the attention is directed at each repetition to some other end than that of learning. One experimenter on memory, for instance, had occasion, in the course of his work, to make those persons, on whom he was experimenting, learn series of words and meaningless syllables by reading these aloud from his notebook, till they could repeat them by heart. Even after accomplishing this with a number of persons, he found that he himself was unable to repeat any of the series by heart, although

he had read them aloud so often. His attention had, of course, been directed towards careful, even, and correct reading, and not towards memorising. So, in other situations, if one wishes to learn by heart, one must continually keep the intention to do so in the forefront of attention, never allowing the mind to slip off for long into other intentions, but making all of those subservient to the one main end. An eagerness and willingness to learn and a joy in making the effort are pre-suppositions of easy and rapid learning. Even with the intention to remember, increase in the power and speed of memory does not come by mere repetition, if the will is not exerted to attain such an increase. At first, of course, the will is hard to stir, but with practice it becomes more obedient, and then only one preliminary effort is necessary. Unpleasant though the work of memorising may be at first, the effort to remember, and the success that is sure to attend it, especially if the most economic methods be adopted, will bring about a change in feeling and will make the work

pleasant. This was found to take place even when the matter to be learned was meaningless. How much more pleasant will the effort be when matter is committed to memory which can delight the mind with its beauty, and engage it pleasantly when weary !

40. How Will aids Memory.

Now, how does an effort of will make learning easy ? The learner's energy is directed towards one end, and is not distributed among several. Disturbing and distracting influences are excluded, and the intention to remember has free scope for its action. In every form of voluntary action the intention is a most important element.*

* It is not a general state, more or less identical for all states of voluntary effort, as attention is ; but it is an active factor in the process of action, and can be brought into play in various ways—*e.g.*, by imitation, by question, by command, or by resolve. It differs in nature and effect for each kind of instruction or command. The effect upon a pupil of the commands, Repeat your verse by heart, Translate it into English, Point out its beauty, is most decisive, and none the less actual as a mental process

The intention is in many respects very much more powerful than the passive material of association, formed by repetition, upon which it acts, and to which it gives unity and individuality. The attempt has been made to measure its power when pitted against well-trained associations, and it has been found that eighty repetitions of an irrelevant association will hardly suffice to overthrow the intention of a trained mind to answer correctly. There are some people whom it is practically impossible to upset in this way. If we wish them to respond to a series of single words in a specified way, and they can do this and firmly resolve to do it, we shall find that no number of repetitions will make strong enough the associations between the words of the series and other words whose recall we do not wish, so as to bring the wrong words out against the intention of such people. The will can be so well-trained that, whenever it is bent to a

because it is so familiar. The difference in the commands is the cause of the difference in the action which follows them, whereas the attention may be quite similar in all.

purpose, it will succeed, if success is at all possible, however great the force of circumstance, association, or habit may be. For this, however, a careful choice of resolves, and thereafter the rigorous fulfilment of each, must become the habit of life. But it must not be thought that, although the intention can rise victorious over false lines of habit or association so persistently, it ceases to feel their influence. On the contrary, it cannot ever completely shake off their influence, for, as has already been said, all rivalry of associations means loss of power and speed of recall. This fact can be utilised for the detection of guilt even against the power of the firmest intention to conceal. To the skilful eye, and more surely to careful observation of the time spent in answering, the presence of irrelevant or incriminating thoughts and associations, even if they be not realised in the mind, is bound to show itself. Apart from systematic training of the will, however, every motive which can be brought to bear upon the chief intention to remember will relieve the will and make work easier. To set

oneself a definite task to be completed in a given time is, for most people, the first step towards fulfilment. Then work begun is work done. In conclusion, the learner acquires by experience a knowledge of the more economical methods of learning. Of course, he will not recognise what can only be found out by a course of experiment and careful measurement, but he learns to avoid wasting his efforts, and he knows when he has done enough to be able to recall with confidence. He pays careful attention to difficult points in his work, and devotes himself to each of them specially. Meaningful associations suggested by the matter in hand are readily grasped, and useless ones do not suggest themselves. Above all, his feelings change, and the willing effort to learn brings with it in time a pleasure in learning, which greatly aids the will. Even in ripe years an effort can produce astonishing results.

41. Pleasant Results help Memory.

It is not only in connection with will that pleasant feelings are an aid to memory. Even apart from it, there can be no doubt that the pleasure resulting from any act, intentional or accidental, stamps this act particularly vividly on the mind. Animals will sooner repeat an act which has once led to pleasant experiences than one of the many random and aimless attempts which may have preceded it. On the other hand, behaviour that has resulted in unpleasant experiences is much less likely to occur again. Thus animals learn their tricks and modify their habits. There is practically no other way of training them. The result of the desired action must be made pleasant, and the animal must be got to perform this action once, no matter how, so long as the displeasure caused by coercion and other circumstances, is not greater than the pleasure resulting from the action. Soon it will perform the action of itself, though slowly and hesitatingly. But if the result is uniformly

pleasant, it will in a short time respond with alacrity to the slightest signal. In this regard children, and in a large degree all men, stand on the same level as animals. They like to do what gives them pleasure, and will put themselves to any inconvenience to attain their ends. Not only that, but anything done or learned that leads to pleasure or benefit of any kind is thereby stamped more firmly in the mind than it would have been had its outcome been unpleasant.

42. Trust the Memory.

The results embodied in the preceding paragraphs yield one rule, which puts the seal upon all learning conducted by correct and economical methods. Learn well and trust your memory. Let us consider for a little what happens when distrust of memory arises, as it does so very often in many people. First of all, distrust of memory discourages the will to remember, and retards the progress of learning (*vide par. 17*). Then, again, when the correctness of what

comes to mind is doubted, the natural thing to do is to recall something else and wonder if it is the right thing. Thus associations with a wrong object of recall are created. These, in turn, block the right one, and, as result, the correct association, which has certainly been formed some time, is just as certainly weakened and wrought into confusion (*vide par.* 24). That is to say, you not only prevent your work from attaining its true value, as in the first case, but you also positively reduce the worth of your work and weaken your memories. As against such distrust of memory, it may be said that what comes first in recall is *probably* correct. What comes compellingly is, if you have learned well, almost certainly correct. Many people, indeed, use the latter as a test of correctness. They endeavour to give way to the mere compulsion of their associations by letting themselves "go" in recall. They think that where distrust arises it is better to lay aside all thoughts and endeavours, and to let the associations bring out what is correct, for at such times effort to recall is not

so much a form of will as a form of nervousness. What comes thus compellingly several times over is very probably correct. Correct recall is usually accompanied by the assurance of its correctness. But of such assurance of correctness we have to treat later. Where it is absent, however, and if we are dealing with unrelated facts, even where it is present, we have no means of seeing or knowing if our memories are correct. Their degree of compulsion is their degree of correctness. No doubt we can, of course, refer to books or to experience anew.

CHAPTER V

MENTAL IMAGERY

43. Introduction.

THE objects around us impress us in various ways. We notice the colours of some and the shape of others. There are many which are best characterised by their sound. Everyone speaks of the rattle of musketry and of the rolling of thunder. Tastes and smells, too, can be called to mind. We think of the rose, and smell its fragrance. What is so characteristic of many houses and shops as the vague, indescribable odour of the rooms and passages? The remembrance of sour fruit sets the teeth on edge, and makes the mouth water. Who does not recall the touch of a cold, unknown object in the dark? These memories are witness to the fact that things often impress us more vividly through one sense than another.

They also show us that we carry the memory of impressions with us, and can recall them very vividly. But at different times we recall different impressions. Talking of motor-cars, we may remember the fresh colours and peculiar shape of some new model just lately seen, or in a less indulgent mood we may think of the clouds of smoke and smell emitted by others. We can hear in our ear the torrent of confused sound, quickly swelling as it rushes towards us, and quickly dying away again. To one who has inadvertently stepped from the pavement in front of a moving car the whole situation will often recur. Sight and sound are lost in the memory of the sudden jerk of the muscles which followed the warning signal of the horn, the stamp on the ground with the foot which just kept him out of its reach, the feelings of strain and pain in the foot which followed it.

44. Results of Early Psychological Investigation—The Three Types.

Knowledge of these facts of everyday experience has been extended by experiment. In fact, the subject of mental imagery was one of the first to attract the attention of investigators. Much interest was aroused by one of the first results of closer investigation, which showed that men differ apparently very much in the kinds of mental images at their disposal. As a consequence, several so-called types of imagery were distinguished. The chief of these were the visual, the auditive, and the muscular types. People of the first type recall colours and forms with ease and distinctness, those of the second sounds, and those of the third movements. These differences become clearer when we notice how the same memory object is remembered by each. The visual type, when he thinks or speaks of what he has read, sees it in print, or in the form of his own handwriting. The word "which," however it may be pronounced, has for him always the appearance of

"wh." The auditive type, on the other hand, is accustomed to hear what he reads, spoken inwardly in his own voice, or in that of someone else. He will often make errors in spelling which originate in the resemblance of the sound of two words, writing "the hold thing" for "the whole thing." The muscular type, finally, makes imitative movements. When he learns he whispers to himself. When he thinks, he does not hear or see the words that flit through his mind. He has them on the tip of his tongue. One will speak often of the beauty of colour and form; the other will fill his speech with expressive and imitative sounds; a third will gesticulate freely, and assume an attitude at every new thought. Of course, other kinds of imagery are common in many people. We know the epicure who discriminates and discusses dishes, tables, restaurants, and hotels; and to the hypochondriac the feelings of cold and warmth, and all sorts of vague discomforts, are never hard to suggest. The mere description of a disease will make many people sick.

45. Later Work.

In this way such types are very easily described and distinguished. But it is much harder to tell how any one person belongs to one type exclusively, or how numerous, relatively to one another, images of different senses are in him. In consequence of this the tendency has for long been to exaggerate the importance of the type to which a man belongs, and to neglect the effect of other influences upon his imagery. The results of recent work, *however, have thrown fresh light on this subject.* These new results seem, of course, to be very obvious and natural, when viewed as a whole, once we have them set before us. But, however natural they may then appear, it is none the less true that practically everyone was blind to them before careful experiment opened our eyes.

46. Factors determining Imagery.

(a) *Manner of Presentation.*

The first influence to be mentioned is the most powerful. It is the nature of the object remembered. We cannot recall a rainbow or a picture as such by the memory of sounds or movements. Nor can we think of a tone visually; nor of a chord muscularly, for no one can sing a chord. They are not composed of sounds or sights. It is therefore not surprising to find that the manner of presentation very often determines the kind of imagery present throughout the whole process of recall. If letters or words are presented and required to be learned, the learner will very often impress them upon himself, and remember them visually throughout, even although they could be remembered in other ways—as, for example, by the sounds or by the motions of pronouncing them. As presented to him at least, they impress his vision more strongly than any other of his senses, and there is a presumption in favour of their being retained as a

direct effect of these impressions. The same learner, on the other hand, may remember a second series of words or letters read aloud to him, with the help of sound images. Here, for the same reason as before, the auditory presentation determines the type of imagery used. The manner of presentation determines in general the manner of learning, while the manner of learning in the same way determines the manner of recall.

47. (b) *Purpose in Remembering.*

A second determining influence is the purpose in remembering. If you wish to remember pictures and sculpture, and to think and talk much of them, you will be greatly handicapped if you cannot remember colours and forms, and your achievement will certainly betray your deficiency. If you wish to be a professor or performer of music, you must at least be able to remember tones and tone sequences. Pianist and composer are able to study their work, and try various effects with the help of

vivid tone memories alone. In every art some one sense is specially involved, and some one class of images is predominant and essential, because all art aims at the creation and appreciation of beauty inherent in or strongly bound up with impressions of one or more senses. So, also, many forms of action and judgment, although they do not involve the actual presence of recalled images, nevertheless presuppose a keen appreciation of and memory for such images.

48. (c) *Predisposition of Individuals to Certain Kinds of Imagery.*

Both the manner of presentation and the purpose in remembering, therefore, tend in general to evoke the same kind of imagery in everyone. But how is it that imagery differs so much from person to person? There must be some factor which varies from man to man, and modifies the effect of the two influences first mentioned, which of themselves would evoke the same imagery in all men. This factor is the natural predisposition of the individual to the

use of one or other sense and to its images rather than to those of another, and it is properly the cause of types of imagery. Such a predisposition may, of course, be cultivated and extended when its owner finds its use advantageous. So it may become strong and habitual out of all proportion to the others, and may thus seem to be present alone, while imagery that seems wholly absent may really be only dormant. The compulsion of some new manner of presentation or new purpose will bring it upon occasion into use. As long, however, as circumstances allow and the main predisposition is strong enough, it may assert itself over the influence of the presentation. Thus, having to commit a number of spoken words to memory, those of the pronounced visual type might remember them not by sound images, but by the corresponding visual images of the words, supplied by the mind of the learner at the sound of each word. So we have types predominantly visual, or auditive, or motor, or types combined of these. There are also persons equally well able to command and use all kinds of imagery. Where the manner of

presentation and learning correspond to the predominant type, there, of course, the conditions for recall, according to the type, are the best. Where the learner, on the other hand, is keenly sensitive to impressions other than those of the predominant type, he may, at the instigation of circumstances, leave the sphere of the typical imagery and follow those suggested.

49. Some External Signs of Type of Imagery.

The type of imagery predominant in any person may be inferred from certain external signs. The visual type shuts or shields his eyes during the process of recall, so as not to be distracted by the sight of things around him. He takes longer to recall than the auditive type, and does not begin to recall so soon after the request to do so. He says what he has learned without strict attention to the order it was presented in, while, on the other hand, he can usually locate each element exactly. Above all, the visual type remembers long and accu-

rately, and seldom repeats erroneously anything already recalled. The auditive type, on the contrary, reproduces faster, if only for the reason that his imagery tends to fade out quickly. He makes few pauses or complete stops if he can recall at all, and recalls in the order given, unless the last group learned reappears first because it is ringing in his ear most distinctly. He is more impulsive in his efforts of memory, is not so certain, and often repeats as new, words already recalled without being aware of it. It is obvious that there are sources of error and weakness inherent in both types. All those who teach will recognise such external differences between their pupils. In conclusion, it is to be noted that most people have command of visual imagery to a greater or less extent. The reason of this is that so many important objects belong to our visual world. A much smaller number of people are also auditive and motor in their imagery.

50. The Scope of Imagery.

(a) *In Action.*

Of the three factors just described, the first two—the manner of presentation and the purpose in remembering—set more or less definite limits to the scope of imagery, as we have seen. The predisposition of the individual, on the other hand, is the occasion of a certain amount of freedom and variety. In regard to general spheres of interest, we saw that pronounced artistic interest and activity presupposes the presence and use of certain kinds of imagery. It is in the sphere of action and knowledge that mental imagery is freest and most varied. Both action and knowledge, indeed, presuppose the presence of certain states, but mental imagery or the like is not amongst these. To know I must have thoughts, and to act I must make movements. A movement may be liberated by any image or mental experience with which it happens to be connected. I may react to a light or to a sound. My movements may be evoked by a thought, a

feeling, a pain, or a touch. Every impression which we have from the senses, whether it come to our consciousness or not, or any mental state whatsoever may come to be the signal for action. The only presupposition is that by some means or other the stimulus which evokes a response shall have been associated with the movement it occasions. In view of the fact that the whole economy of the organism can be conducted in the absence of consciousness, it would be absurd to imagine that any one kind of mental experience must precede movement.

51. (b) *In Thought.*

So with thoughts. We are all naturally stimulated to our first thoughts by the words spoken to us in childhood. First of all, objects are pointed out to us and named; we learn to associate words with things, and, in a way that is not understood at all yet, we are stimulated to thoughts by the changing relations of the things that are pointed out to us. Words can

be so arranged as to mean some relation in which objects stand to one another, and we can have thoughts which embody these meanings for us without the words. In fact, it is necessary to have the thoughts before we understand their meaning. Doubtless a certain arrangement of the objects which stand in a given relation to one another, a certain frequency of recurrence of these relations, a certain importance of these for our welfare, all this and much more is necessary for the appearance of the relevant thoughts in us. But vague as is our knowledge of the adequate stimulus for thoughts, we may be sure that a good deal of variety is possible. Children have learnt to speak and read by other means than by hearing the words spoken. The deaf, blind girl Helen Keller learned to speak and acquire thoughts through her sense of touch. Thought as such is independent of all mental imagery, and there is therefore little reason to suppose that any form of mental imagery forms a predominant part of the adequate stimulus for thought in general, although it may, of course, be relied on

to any extent by a given individual. Generally speaking, then, knowledge makes no presuppositions as to mental imagery. The culmination of psychical activity, where knowledge is concerned, is either the knowledge attained, or else the expression of it by means of some muscular activity—for instance, speaking or writing. So long as the initial disposition and inheritance of the individual mind does not make one or other method easier, or so long as the object to which the knowledge refers does not make one or other method more appropriate, it is indifferent by which process the ends of knowledge are attained. And so we find it: the use of images in thinking varies with the object of thought, and with the purpose or predisposition of the individual. Visualising, speaking to oneself, or speaking or reading aloud, is in general no aid to thought, though any one person may find one of these devices, or any other for that matter, to be a source of distinctness, clearness, or briskness of thinking for himself. On the other hand, we find that visual imagery forms a frequent

accompaniment to the processes of thinking, for the reason that our largest material world is the visual one.

52. Inferences.

(a) Do not Multiply Imagery Unnecessarily.

What inferences can be drawn from all this with regard to the economy of memory? If there are any it seems at least clear that they must be more restrained and fewer than they have usually been. In the first place, it must be emphasised that there is not the slightest use in multiplying forms of imagery in the process of learning in the hope that memory will thereby be stronger and more reliable. Energy should be concentrated on one method so that it becomes reliable. To rely on a second method is simply to learn the whole thing over again as if it were new. There is, then, no need to read aloud, if merely looking over what is to be learned suffices; nor should we write out words, phrases, or conversations if they remain in the memory when merely heard.

53. (b) *Positive Rules.*

Positive rules may be constructed in the first place from two points of view according to the purposes of memory work. If knowledge is being acquired for its own sake it matters little how it is acquired, so long as it is permanent and recurs readily to the learner. He may be guided simply by the intention to know and to learn zealously, and may leave this effort and his own predisposition to suggest the most appropriate lines of imagery. On the other hand, if there is some definite purpose in view, such as that of reciting, public speaking, examining, it is well, in the course of the process of learning, to approach as near as possible to the conditions of reproduction. The reciter, even if visually disposed, must recite very often in private, or to a small circle of friends, before submitting to any critical test. His first learning may, as a matter of course, be visual, but by practice in reciting he will arrange and perfect the association with the muscular me-

chanism, and by this alone, or perhaps by converting the visual into auditory imagery get over the hesitation and frequency of pauses peculiar to work with visual imagery. It is unnecessary, and might even be harmful, to suggest rules for the control of imagery in these cases. The imagery suitable to each case will come of itself under the compulsion of the task set for recitation. Moreover, the reciter will find that the imagery involved in his work changes in nature the more perfected his complete performance becomes. So too, in public speaking. Private meditation is not practice for public speaking as such. A clear arrangement of topics, mostly on the basis of visual presentation; a habit, mainly auditive or muscular, of recalling phrases and forms of speech, and of uttering these—when recall is once started—without further attention to them; the habit of free attention to circumstances and succeeding thoughts thus made possible—all such things, and many others which appear and grow out of actual practice, are necessary before a finished speaker is made.

Many make the mistake of supposing that the preliminary to a speech must be the power of seeing it all before the mind's eye, or of hearing it all in thought, or even of saying it all by heart. None of these things is necessary, though, just in so far as they approach the realisation of the actual process of speaking, each of them may be a help. Just in the same way the habit of writing out summaries of answers, practice in solving problems readily at first glance, and acquired skill in composition, is good support in the work of written examination; and yet the student, well-seasoned in such tests, may make a bad appearance in oral examination, for lack of practice in reasoned debate involving constant recourse to knowledge of fact and theory. If time is allowed, his knowledge may, of course, be found to be perfectly sound. But very often the time involved in recasting the associations, which must precede test action, is not given. Here one mechanism or practice stands for another only in so far as some common element—for

example, the necessary thoughts—are involved. The actions are, however, different, and the highest skill in action, even the most similar kinds of action, is acquired only by very long practice.

54. (c) *In General, Visualise.*

Finally, it may be repeated, visual presentation and learning generally secure a more reliable recall, and auditory presentation and learning a more rapid and unhesitating recall. It is for this reason that the visual mode of presentation is adopted in so many systems of memory training. Correctness of recall, apparently after one reading, impresses an audience greatly, while the slowness of recall and slight hesitation is easily condoned. Lightning calculators, on the other hand, must be ready and rapid, and so we find that these seldom rely on visual imagery, but trust to enormous practice and familiarity with all possible or likely questions and their answers, or, in more genuine

cases, answer by motor impulse, or at the suggestion of the auditory image of the answer, probably on the basis of pure thought-work.

55. (d) *Work in Groups. The Teaching of Children.*

So much for solitary work. Where a number of persons are being taught together, it is advisable to give each an opportunity of learning in his own way. This is more necessary in the case of children, because they have as yet little or no knowledge of their habits of imagery, and little practice in converting one kind into another. Their learning is, therefore, for the larger part determined by the mode of presentation. Where mode of presentation and the predisposition of imagery agree, there they will learn well and readily. Where they do not agree, the chances are they will not learn at all, or only very slowly. For this reason the objects of study or pictures of these are shown. Words are written on the blackboard, while

the teacher pronounces them, and encourages the child to repeat aloud after him, to use the word in an answer, and at times to write about what has been taught. Thus, every child is likely to bring those images into play by which he remembers best. From acquiring and learning, the child is gradually led on to the practice of muscle, imagery and thought, presupposed in the various forms of skilled action essential to modern life—speaking, reading, writing, calculating, and, at its best, thinking and sympathising. It is better to write out strange foreign words and names, because the visual form must by convention always be full and correct. Spoken forms of speech, on the other hand, are usually reduced to the minimum necessary to suggest the word in question. But a foreign word spoken is hardly so strange or hard to remember as the same word written in quite unfamiliar symbols (e.g., Arabic). From what has been already said about the general predominance of visual imagery, it will follow that as children get older the visual form of presentation, as by

printed page and blackboard, will become more and more popular. The need for visual and pictorial demonstration is being recognised more and more in our higher education.

CHAPTER VI

ON THOUGHTS

66. There are Thoughts.

THOUGHT as such, as we have said (par. 51), is independent of all mental imagery. Such independence implies, of course, a radical distinction in kind between thoughts and images. The observant reader who is not versed in current theories of the more complex work of the mind or of the brain will scarcely find it hard to make this distinction. Yet it has been long generally accepted opinion that thoughts consist of complex groups or trains of imagery of various kinds, but not in actual appearance than what we know as mental imagery, but having a strength, persistence and pervasiveness all their own, and steering in their activity and influence the lower levels of the consciousness. Indeed a large

part of the imagery which constitutes thought was supposed to lie outside these limits, and thereby to procure for thought, as that part present in the mind, its subtle delicacy and vast comprehensiveness. If we but think how such a theory arose, we shall see at once that we may not call it stupid or absurd. Its value and strength lay in the fact that it seemed to trace a course of mental development from the simple and elementary stimulation of the senses and the image left thereby up to the most complex operations known. This theory appealed with great success—perhaps even with most success—to those specially interested in the structure and disease of the brain. For it bears some resemblance to the view that the latest development of the brain, as seen in man, is a structure of appalling complexity, gradually built upon and compounded of the simplest nervous elements. Disease of the brain, too, shows that this complex structure may be damaged in limited and quite definite ways, so that visual images, or words, or movements of one or other limb or muscle,

are lost. Ideas, therefore, such as cigar, spoon, came to be considered as aggregations of all images derived from these objects or excited by them—sights, sounds, smells, tastes, motions, and the like. And yet just such very cases showed often that the theory was not quite complete. For alongside these various well-known images a special place had to be found for understanding and meaning. When at last the incongruity of confounding thought with groups or complexes of imagery was pointed out clearly, a distinction between them had to be made. Thoughts have a meaning and embody knowledge, while imagery is never more than it just happens to be in our minds. Besides, thoughts may occur suddenly, revealing knowledge, memories, and problems of the most far-reaching nature, without materially adding to the mental imagery present at all. Whatever their actual nature may be, there can be no doubt that thoughts must be recognised to be a peculiar form of mental experience, just as feelings are. And yet at one time vigorous endeavours were made to build up feelings out

of sensations of various kinds. This attempt has now been completely abandoned, as will soon be also the attempt to form thoughts out of imagery.

**57. Laws of Memory for Thought differ from
the Preceding.**

or trains of thoughts would be remembered much more easily and better than complexes or trains of images ? A series of twenty well-marked ideas—as, for instance, striking proverbs or maxims—will be retained to some extent even after one reading. Of course, the whole series could not then be repeated spontaneously, but the mention of some decisive word from each proverb, or of another proverb with a similar meaning, will suffice to recall any given one immediately. Of a series of thirty such proverbs, read aloud once, with a short pause for reflection after each, a good memory can reproduce correctly the main thought, and perhaps even the exact words, of as many as twenty-seven. The same holds good for thoughts which are elaborated by the hearer with the help of suggestive phrases which are to be remembered. If we construct a long series of pairs of such phrases—*e.g.*, Homer and the Bible, the unity of mankind; supreme genius, gentlest modesty; nationalisation of art, patriotism run mad, etc.—and read these slowly to a listener, allowing him time to form

a link of thought between the members of each pair, we shall find that, on naming the first member of each pair to him in haphazard order, he will reproduce the thought or the words of the other members correctly in most cases. Out of twenty such pairs, seventeen to eighteen can usually be recalled correctly. But if we read once twenty words from a strange language, with their meaning in English, we should with difficulty remember even a small fraction of them.

58. Some Explanation of the Above.

This ease in remembering thoughts can be understood to some extent from what has been already said about the learning of familiar matter (par. 31). Familiar matter should be learnt by repetition of the whole piece. No trouble need be taken with the single members. Now, the elements of such pairs of thoughts are more or less familiar—so familiar, at least, that it is not quite fair to compare them with words from strange languages, which belong

rather to the type of unfamiliar matter (par. 32). The only work that has to be done, therefore, is that of binding the one to the other by links of association or of thought. If thought is to be the connection, the elements must be of such a kind that they will readily suggest a distinctive thought link. Pairs of ideas, like Thames—river, Darwin—scientist, hotel—street, would not thus excite thought, and would therefore probably not be remembered for more than a few minutes or hours, if at all. The thought links suggested by such familiar ideas are themselves too obvious and commonplace to be more effective in recall than mere associations. It would be simpler to learn the whole series by repetition. Of course, even a series of most suggestive ideas could be learned by mere repetition and association, and such associations do doubtless often play a part in the recall of thoughts. But the part they play is very small. Thought links and thought resemblances are much more powerful. Thought links seem often to consist of a special state of knowledge of what is to be recalled.

Some peculiarity or some circumstance of the first appearance of this idea, the thought of the relation in which it stands to the other, some feature common to both—this or any other idea which has been suggested by the two ideas to be remembered, and which forms a complete idea with them, will serve as a powerful means of recall. The more inevitable the idea which binds those to be remembered, the more likely it is to be unfailing in its action. Simply because the two ideas to be connected demand some one particular link or connecting idea to make them complete, does the presence of any one part of this whole lead to the recall of all other parts. The necessity of such recall is less, of course, the poorer, weaker, or less individual the combination of ideas is. In this way the learner may be aware of the detailed thought even before its recall. He may be aware what sort of a thought he has to recall, how it is related to the thought that suggests recall, and whether he can or need recall it correctly and fully, or not. It is clear that here we have a process of recall which is much more

characteristic and much more reassuring than that of mere association. Here we get almost a conscious embodiment of reliability of memory. It brings with it, besides, its own measure of trust, which no one would think of doubting. Yet there can be no doubt that the assurance such thought memories often bring with themselves is also based ultimately upon reproductive compulsion. The only difference is that this compulsion is built upon a specialised group of thoughts, which cling together longer because of their internal relations of meaning.

59. Thought Links as an Aid to Memory.

The ease with which thoughts procure recall has been known in a rough way for very long. It has been one of the mainstays of most memory systems. Some ingenuity in inventing thoughts to link even the most incoherent words together is presupposed. The more appropriate these thought links are, the more naturally they are suggested by the words to

be remembered, and the more unique they are, the stronger and surer will the memory be. Where the thought links are not very appropriate or striking, the most they can do is to reinforce for a time the mechanical associations. Such a method of reinforcing associations is useful and powerful, wherever it is possible and advisable to apply it. There are, indeed, some people who learn almost constantly by the help of thought links where others use imagery. Their learning consists in noting likeness, differences, relations, size, etc., of the elements of the piece to be learned, and they recall with the help of these. In the same way constant comparison of our thoughts and experiences with one another is a great help in the study of any subject. By thinking over our experiences, we not only create new thought links between them, but we work them up into coherent and therefore easily remembered systems. It would, however, be intolerable to apply the method indiscriminately to learning. It would debase the faculties of thought, which are the vehicles of truth and of objective mean-

ing, to the mere level of a mechanism, already perfectly supplied by association. In most cases the use of thought links would simply be a means of shirking the slight amount of work involved in committing a series of words to memory by association in the most economical manner. Besides, the use of thoughts is not a matter of mere economy. Bad usage makes the best tool bad. Thought must be kept as far as possible to its proper use in order that it may grow more efficient in that use. Its proper use, of course, is to follow the compulsion of objects and of the relations between objects. The more true and natural the thought links are that are invented to bind one idea to another, therefore, the more lasting and the surer will be recall.

60. The Place of Memory in Conscious Life.

In the learning of any matter in which thought plays an essential part, it ought never to be lost from sight. Man does not live to remember, and any system of education which

appeals mainly to the memory has so far failed to meet its purpose. Man lives to think, to know, to feel, and to do, and to have constant pleasure in all these. Memory is only a means thereto. It is the means by which an animal is enabled to perform an acquired act swiftly and appropriately, and so to fulfil its natural instincts of self-nourishment and self-defence. It is the means by which man extends his world of objects beyond the mere animal present into the past, and out of the material world into the ideal and dream of the future. Apart from professional tasks, therefore, memory as such has no value for learning. It is only the thoughts and knowledge embodied in words, only the beauty inherent in the symbols to be learnt, which we cherish. Knowledge and beauty are bound up very closely with their means of expression. They ought to be grasped in some manner from the very first, before the

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CHAPTER VII

RULES FOR THE ECONOMY AND TRAINING OF MEMORY

*(The numbers in brackets refer to the paragraphs
in the text.)*

1. *You never had a better memory, if you are in good health, than you have now (v. 17).*
2. *Be interested.* Let the needs of life or the love of knowledge, of beauty or of good actions rouse in you the desire to learn (v. 19).
3. *Do not try to improve your memory.* Try to learn better, then you will remember better (v. 1, 4).
4. *Begin carefully.* The first survey of any matter to be learned is very important. Make it slow, careful, and correct. Mistakes of all kinds must be carefully avoided (v. 24).

man she has revealed a reason for carrying this development very much farther. She has given him knowledge and appreciation, and wherever these are impossible or only imperfectly realised without skilled performance, there technique is most valuable. Without the spirit of truth and beauty, memory is but the graveyard of experience.

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4. *Begin carefully.* The first survey of any matter to be learned is very important. Make it slow, careful, and correct. Mistakes of all kinds must be carefully avoided (v. 24).

5. *Repeat often.* The oftener words, thoughts, actions, or any experiences whatsoever are brought before the mind, passively or actively, the more likely they are to reappear there (v. 22).
6. *Will to remember.* In learning, keep the intention to remember ever before the mind. However much practice you may have had, renewed effort will give you still greater ease and skill (v. 39, 40).
7. *Learn familiar matter as a whole.* In learning familiar matter of moderate length, read through the whole piece repeatedly till it is learned. Do not learn little by little or verse by verse (v. 26, 28).
8. *Learn unfamiliar matter in parts.* If the matter is unfamiliar or full of special difficulties, repeat fragments of it or parts containing such difficulties separately, until these become familiar and easy; then learn the piece as a whole (v. 27).

9. *Short sittings.* Do not try to learn a thing all at once. Spread your repetitions over a number of sittings, long enough to interest you and get you into swing, but much too short for fatigue (v. 29, 30, 31).
10. *Pause after work.* Allow the mind to wander at will for four or five minutes after each sitting. Do not turn at once to new work (v. 33, 34).
11. *Pause during work.* Do not take too big mouthfuls. Learn deliberately, pausing for an instant every now and then, increasing the speed only as the piece settles in the memory (v. 34, 35).
12. *Learn well before recalling.* Do not try to recall from memory at all, until you feel little doubt it will be quite successful. During the first recall consult the text at once when doubts arise (v. 24). Do not try to recall between sittings (v. 24, 30, 31).

13. *Trust the memory.* What comes compellingly to it is, if you have learned well, almost certainly correct. When in doubt, do not question, but just "let it come" (v. 42, 58).
14. *Time will tell.* To know if what you have learned has become a permanent possession of the memory, leave it for a week, month, or year, as the case may be. Then recall without any preparation. All failure, hesitation, or uncertainty in recall is then a sign of imperfect or disturbed associations. In relearning, devote special attention to these (v. 32).
15. *Use a rhythm* in learning, as far as possible, and stick to it throughout (v. 36).
16. *Learn fast, if need be.* If a limited and rather short time is allowed for learning, learn as fast as possible, but not so fast as to agitate or distract the mind (v. 37).

17. *Do not multiply imagery unnecessarily.*
If you know your predominant form of imagery, learn according to it as far as possible. In most cases, however, it is better not to think of it at all, but just to learn hard (v. 52).
18. *Systematise and visualise.* Systematise what has to be learned as much as possible. Still better, visualise it, if you can do so easily, or learn it from paper (v. 38, 54).
19. *Learning is just practice for recall.*
Therefore make the process of learning as like that of recall as possible (v. 53).
20. *Thought links*, especially when the matter to be learned readily suggests them, are a valuable aid to quick learning (v. 59).
21. *Slow but sure* recall is guaranteed by thought links and visual imagery. Auditory and mechanical learning make recall *prompt and swift* (v. 37, 49).

22. If you have to learn things by heart,
take a pleasure and pride in it (v. 41).
23. Give your pupils every opportunity of
acquiring by imitation habits of
economical learning.

THE END